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PCT/NZ2004/000191

CERTIFICATE

This certificate is issued in support of an application for Patent registration in a country outside New Zealand pursuant to the Patents Act 1953 and the Regulations thereunder.

I hereby certify that annexed is a true copy of the Provisional Specification as filed on 21 August 2003 with an application for Letters Patent number 527759 made by GLOBAL TECHNOLOGIES (NZ) LTD.

Dated 31 August 2004.

PRIORITY DOCUMENT
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NEW ZEALAND

330 High Street, Lower Hutt and 17 Toop Street, Seaview
PO Box 30687, Lower Hutt, New Zealand or DX SX 11129, Wellington
Phone: +64 4 560 1600, Fax: +64 4 560 1691, www.iponz.govt.nz

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PROVISIONAL SPECIFICATION

SAMPLING DEVICE

We, **GLOBAL TECHNOLOGIES (NZ) LTD**, a New Zealand company of Floor 1, 218 George Street, Dunedin, New Zealand do hereby declare this invention to be described in the following statement:

PT043766109

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SAMPLING DEVICE

FIELD OF INVENTION

This invention relates to a device for sampling fluid or material from a wetted surface. In particular, the invention relates to a device having a ball mounted within a socket, so that the ball is free to rotate in any direction, enabling the ball to be rolled across a surface so that the ball contacts a fluid sample on the surface and the fluid sample is transferred by the ball past the socket and collected by an absorbent material.

BACKGROUND

In many fields of technology samples of fluid, or material suspended in fluid, must be extracted from a surface for subsequent analysis of the fluid or material suspended in the fluid. There is a variety of well known devices available for achieving this, although many have disadvantages or have limited application to certain sampling and analysis processes.

Some known devices are instruments with sharp ends, such as biopsy or syringe needles. Needles often damage a surface when obtaining a fluid sample. In many instances, this is an undesirable but necessary consequence of using a needle. In addition, needles require a certain degree of care by the user to prevent injury to the user. The sampling of a fluid taken from a human or animal with a sharp ended instrument can cause pain and injury.

Sharp ended fluid samplers, such as needles, are also not desirable for use in some industries, such as the food production industry, due to the possibility of needles breaking or falling into the food and therefore posing a serious health and safety risk to consumers.

Another well known fluid sampling device is the pipette which is available in many different embodiments. Some pipettes are precision engineered instruments making them expensive and requiring expert knowledge for correct use. Other pipettes are simply a capillary with a rubber bung attached at one end to produce a vacuum when in

use. This type of pipette does not yield reproducible sampling results and can not be adopted for high throughput automated sampling. Furthermore, neither pipettes nor needles are well suited to sampling very small volumes of fluid especially where the fluid is present as a very thin film.

Another device used to sample a fluid material from a surface is a swab of absorbent material, such as a cotton bud. This type of sampler does not yield reproducible sampling results and has the added disadvantage that extracting the fluid for analysis after sampling can be difficult. Furthermore, swabs are not suited to high throughput automated sampling.

More sophisticated devices based on the use of an absorbent material on a rotating element have been developed. For example, US 5,554,537 describes a device having a flat element with a compressible absorbent material, surrounded by a chamber. In use, the wall of the chamber forms a seal against the surface from which a sample is to be taken. The absorbent material is then compressed between the sample surface and the flat element, and rotated in a direction parallel to the sample surface. This configuration has the advantage that the absorbent material can be pre-wetted and therefore a dry surface can be sampled. Furthermore, the rotation of the absorbent material effectively scrubs the surface thereby obtaining a better sample. However, correct operation of the device requires a seal to be formed between the walls of the device and the sample surface. This may be difficult or even impossible in some uses.

Another example is US 6,266,838 which describes a device having a rotating drum with an absorbent material on its outer surface. The device is designed to mop up fluids spilt on a hard surface. The device also has an element that engages the absorbent surface and channels water away from the absorbent surface to a container as the drum rotates. This device suffers from the disadvantage that the absorbent material must be one that can be adhered to the drum, rather than a powder or granular resin as may be preferred in many uses. Further, this device is not well suited for sampling small volumes of fluid.

There is a need for a sampling device that can extract fluid samples, including small sample volumes, from wetted surfaces and can be operated without expert knowledge.

The applicant has now surprisingly found that a device having a ball in a socket is effective for sampling fluid, where the device additionally has a means for collecting the fluid sample in readiness for analysis of the sample.

Ball in socket devices are well known as devices for dispensing a fluid contained in a reservoir to a surface. Such devices include "roll-on" deodorants/anti-perspirants, sunscreens, cosmetics, and other ointments or creams, as well as ball point writing pens.

A ball in socket dispensing device, however, does not have the same technical difficulties as a sampling device. A dispensing device needs a reservoir of fluid to be dispensing, but once dispensed the fluid requires no special treatment in relation to containment or application. In contrast, a sampling device must have an adequate means of collecting the sample from the ball and making it available for subsequent analysis. It is presumably for this reason that ball in socket sampling devices are unknown to date. The applicant has now discovered a way to successfully overcome these technical difficulties.

It is therefore an object of the invention to provide a sampling device that at least goes some way to overcoming the above disadvantages of known sampling devices, or to at least provide a useful alternative device.

STATEMENTS OF INVENTION

In a first aspect of the invention there is provided a device for sampling a fluid including:

(a) a ball housed within a socket where at least part of the external surface of the ball is capable of contact with a fluid;

(b) a chamber shaped at one end to form the socket and at the other end to form a sample collection reservoir;

(c) an absorbent material housed within the sample collection reservoir, where the external surface of the ball contacts the absorbent material;

(d) an outlet to allow fluid to pass from the reservoir; and

(e) a filter proximal to the outlet to contain the absorbent material in the reservoir but to allow fluid to pass from the reservoir.

It is preferred that the device further includes a sample fluid conduit connected to the outlet.

Preferably the device is longitudinal with a substantially circular external wall cross-section and houses the ball, the socket, and the chamber. The device preferably includes a handle formed as a shaft containing at least part of the conduit.

The handle may be integrally formed with the socket or, alternatively, the socket may be mounted to the handle so that the handle is detachable.

The absorbent material may be any absorbent material suitable for the sample fluid, but, in the case of a fluid sample obtained for DNA analysis, is preferably a resin capable of deactivating nucleases, such as Chelex®.

The device preferably includes a cap for each end of the device so that the device can be sealed both before and after obtaining a sample of fluid.

The surface of the ball may be smooth, or may be textured or roughened to minimise slippage of the ball on a surface when in use.

The device preferably includes a heating means to heat the fluid sample once collected. Preferably the heating means is a heating element located in the socket or in the handle of the device.

The device may be constructed of any suitable material, but preferably a metal or a plastics material.

In a second aspect of the invention there is provided a method of obtaining a fluid sample using the device of the invention.

DETAILED DESCRIPTION

The device of the invention is intended to be used to extract sample fluid from a wetted surface. The sample fluid may be any fluid whether biological, such as blood, or non-biological, such as waste from a chemical plant, and may be a synthetic fluid or a non-synthetic fluid, and includes any material or substance suspended or dissolved in the fluid.

The term "absorbent material" is intended to cover any absorbent substance required for the sampling being undertaken, whether particulate, granular, powdery, fibrous or a solid porous matrix such as a sponge, whether synthetic or non-synthetic, whether hydrophobic or hydrophilic and whether inert or reactive with the sample fluid.

In use, the ball of the device is rolled across the surface on which the sample to be collected and analysed is present. The fluid sample contacts the absorbent material in the reservoir as the ball, with sample on its external surface, rotates. The ball is therefore in direct contact with the absorbent material to ensure that the fluid sample contacts the absorbent material and is retained in the reservoir.

The invention is further described by way of example with reference to Figure 1. It is to be appreciated that the device shown in Figure 1 is one example of the invention and that the invention is not limited to the example.

A sampling device 1 comprises a solid sampling ball 2 housed within a socket 3. The ball 2 is free to rotate in any direction and has a surface that can range from substantially smooth to textured. The textured surface must be sufficient to provide adequate friction for ball rotation against the sampling surface. The socket 3 is attached to or built into the end of a handle 4. The handle of a device of the invention may be configured to suit a particular application for the sampling device. In the device 1 illustrated in Figure 1 the handle 4 is a shaft.

The socket 3 comprises an opening 5, through which the ball 2 is exposed to the atmosphere and is accessible to a wetted surface for sampling. The small gap between the ball 2 and the socket 3 represents the sample inlet 6. The diameter of the

socket opening 5 is smaller than the diameter of the ball 2, thus preventing the ball 2 from falling out of the socket 3.

The inner wall of the socket 3 has a concave portion 7 so that there is a snug fit with the ball 2. The inner wall also has a tapered portion 8 that tapers away from the ball 2 to form a space 11 behind the ball 2. The space 11 has a sample outlet 9 which is sealed with a physical barrier 10. The sample outlet 9 is shown in longitudinal alignment in the device 1 with the socket opening 5. However, it is to be appreciated that the sample outlet 9 may be positioned at any angle relative to the socket opening 5.

The socket 3 is shown integrally formed with the handle 4 of the sampling device 1. However, the socket 3 may be independently mounted to the handle 4 in an alternative construction of the device.

The space 11 contains an absorbent material 11 which is in direct physical contact with the ball 2. This contact is necessary to enable fluid to be absorbed into the absorbent material. As will be appreciated by those skilled in the art, the absorbent material will be selected depending upon the nature of the fluid being sampled and/or the type of subsequent analysis to be carried out on the sample. The nature of the absorbent material needs to be consistent with the wetting fluid or fluid to be sampled. For example, a hydrophobic fluid will require that a hydrophobic absorbent material is used in the sampling device.

The absorbent material is held in place within the device 1 by the ball 2 and the barrier 10. The ball 2 is effectively a valve. The gap 6 between the socket wall 7 and the ball 2 is sufficiently small that the absorbent material in the space 11 cannot leak out of the socket opening 5. The barrier 10 at the sample outlet 9 must be permeable to air, wetting fluid and sample fluid to enable fluid to move through the absorbent material. However, the barrier 10 must not be permeable to the absorbent material. The barrier 10 is therefore a filter.

The sample fluid outlet 12, comprising the outlet 9 and barrier 10, is connected to a conduit 13 through which the sample fluid can be transported by applying a vacuum to

the conduit outlet 14. The conduit 13 is housed within the handle 4 of the sampling device 1.

Both ends of the sampling device 1 can be sealed before and after use with removable caps (not shown).

The handle 4 of the sampling device 1, and the conduit 13 housed within, may be configured with adaptors or fittings to facilitate connection to other devices for further processing or analysis of the sample fluid.

The sampling ball 2, socket 3, and the handle 4 may be constructed with a suitable metal, or a plastics material, or composite materials.

In operation, the ball 2 extracts a sample fluid from a surface by making physical contact with a wetted surface and is rolled over the wetted surface in one or more back and forth strokes, or circular movements.

The surface being sampled is preferably sufficiently textured to provide enough purchase to prevent slippage of the ball 2 and to enable the ball 2 to rotate within the socket 3. In situations where the sample surface is too smooth, a portion of the sample can be put onto an artificial textured sampling surface such as a gauze mat.

The surface to be sampled may be inherently wet or it may be dry. If the surface is dry either the surface or the sampling device is subjected to an extra preparative step prior to the sampling process. A dry surface can be wetted prior to sampling by applying a wetting fluid, or a fluid containing a substance or material to be sampled, using any wetting method but preferably spraying. Alternatively, a dry surface can be sampled using a pre-wetted sampling device 1. When the device 1 is pre-wetted, the absorbent material in the space 11 is fully or partially saturated with wetting fluid.

During sampling, sample fluid from the surface being sampled adheres to the surface of the ball 2 via surface tension. As the ball 2 rotates, the sample fluid is transferred through the sample fluid inlet 6 and into the socket 3, where upon the fluid contacts the absorbent material in the space 11. The fluid is absorbed into the absorbent material.

When tissue extracts or biopsies (e.g. a sample of sheep meat) are being sampled, the shearing force of the ball 2 rotating within the socket 3 causes mechanical damage of the tissue to achieve tissue fragmentation or cell dispersal, and/or the release of fluid from the tissue.

In some applications it is desirable that the sample fluid, during or after extraction from the wetted surface, is heated and/or cooled. This can be achieved by placing either the entire device 1, or the exposed portion 2a of the ball 2 into or onto a suitably configured temperature controlled device. Physical contact between the device 1 and the temperature controlled device facilitates heat transfer between the said devices, resulting in heating/cooling of the sampling device. Alternatively, the device 1 can be configured with a built-in means of heating, such as a heating element located in the socket 3 and/or handle 4.

When a heating or cooling step is desirable, either the ball 2 or the device 1 is preferably constructed of a fully- or semi-heat conducting material. It will be appreciated that both the temperature and the period of heating will be selected depending upon the nature of the sample and/or the nature of the absorbent material and/or the type of subsequent analysis to be carried out on the sample.

If there is significant evaporation of water from the absorbent material during heating of the device 1, water can be replaced by rolling the ball 2 over a re-hydration fluid, which will be wicked up and hydrate the absorbent material.

After a surface has been sampled, and sample fluid has been absorbed into the absorbent material, the said sample fluid can be directly removed from the device 1 or it can be stored within the device 1 for a period of time. The preferred method of removing sample fluid from the device 1 is by applying a vacuum to the conduit outlet 14. This can be done either directly by connecting a vacuum device, e.g. a syringe, directly to the conduit outlet 14, or indirectly by applying a vacuum to other conduits or chambers that may be connected (not shown) to the conduit outlet 14.

The invention can be operated manually, or alternatively can be robotically controlled and operated throughout the sampling process.

One possible application of the invention is in the sampling of biological samples (e.g. meat, skin, plant material, microbial cultures) for the purpose of extracting cells and optionally for processing the cells in readiness for subsequent analysis, such as DNA, protein, carbohydrate or lipid analysis. If the device 1 is used to obtain a sample for DNA analysis, the absorbent material is preferably an absorbent resin covalently linked with a chelator of bivalent cations, e.g. Chelex®, which, by chelating bivalent cations, leads to the inactivation of nucleases.

During operation of the device 1 for obtaining DNA analysis samples, the ball 2 picks up or extracts cell-containing fluid from a wetted surface (e.g. an animal carcass, or a processed meat product) and transfers the cell-containing fluid to the space 11 of the ball 2 into the absorbent Chelex® resin. The device 1 is preferably heated to facilitate heating of the resin to a temperature in the range 75°C to 98°C. The heating protocol is selected according to the heat conductance of the device 1 or the ball 2, and according to what temperature is reached in the absorbent resin. For instance, the device is heated for 4 minutes if the resin temperature is 75°C. The purpose of heating the device 1 in this operation is to promote lysis of the cells in the sample fluid, inactivate nucleases released from the cells, and denature the protein scaffold in chromatin. The DNA from the cells is therefore stably prepared and accessible for subsequent processing or analysis.

The device of the invention may be used in any application where high throughput, automated sampling is desirable. The device can be constructed as a portable pocket-sized device for low throughput manual sampling. The device will in most applications be used only once and will be disposed of after sample fluid has been removed from the device.

The device of the invention has the particular advantage that it is very easy to use and does not require expert knowledge to operate.

A further advantage of the invention is that the device can be configured to sample small volumes of fluid (in the millilitre range or microlitre range) by changing the volume of absorbent material in the device.

Other advantages include:

- ability to obtain small sample volumes
- non-invasiveness
- avoidance of hazards associated with using sharp needles
- minimal disruption or damage to surface from which sample is obtained
- suitability for high throughput sampling
- portability

Although the invention has been described by way of example, it should be appreciated that variations and modifications may be made without departing from the scope of the invention. Furthermore, where known equivalents exist to specific features, such equivalents are incorporated as if specifically referred in this specification.

GLOBAL TECHNOLOGIES (NZ) LTD

By its Attorneys
BALDWIN SHELSTON WATERS

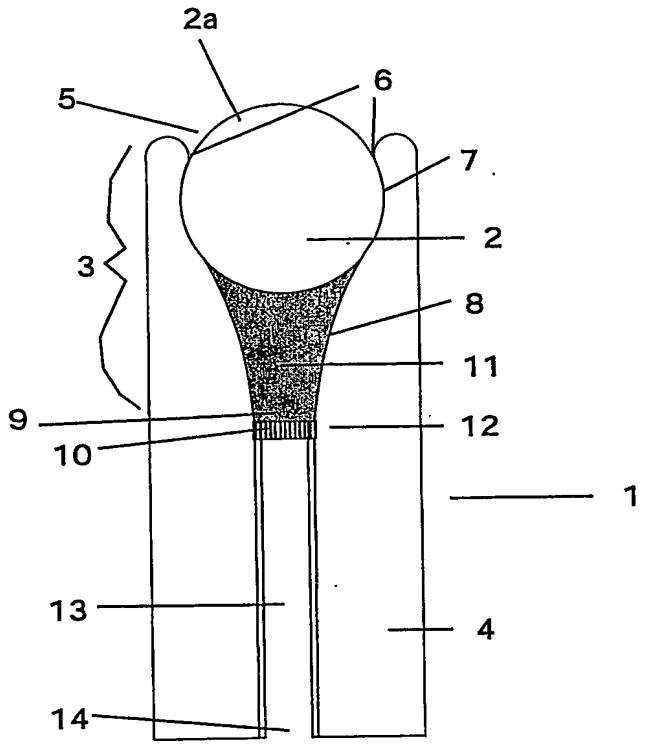

Figure 1